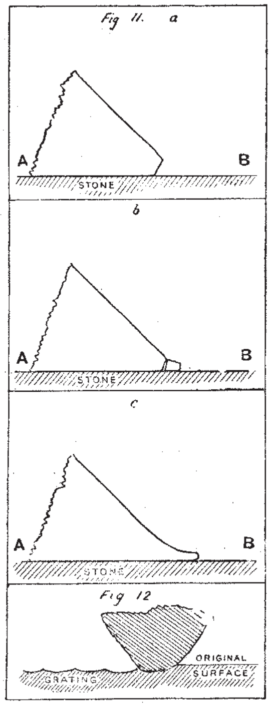
Using an unsoftened needle so mounted that very light pressure might exist between it and the grinding stone, a point was produced which appeared perfectly sharp under a microscopic power of 300 (Fig. 4). How sharp this really is is quite uncertain, for probably the same appearance would be presented whether the radius of curvature were one-half or one-hundredth of a wave-length of the light used in its examination.

I believe, however, that, short of molecular dimensions, there is no limit to the sharpness attainable if sufficiently light pressures are used in grinding.

In order to get some idea of the chance which a fine steel point would have of surviving when in use, I dropped a needle weighing about 3 grains through a distance of 1 in. on a glass surface. The result is shown in Fig. 5.



FIGS. 11, *a*, *b*, *c*, and 12.

It would seem, therefore, that though it might be just possible to rule lines separated by 1/100,000 in. with a steel point, great care would be required, especially in bringing the point into contact with the film at the beginning of each line.

What happens in the process of grinding is indicated in Fig. 11, *a*, *b*, *c*. Suppose that a truncated cone (*a*) is being ground, and that the pressure between it and the stone is at first uniformly distributed along the line AB; as grinding proceeds it is evident that the pressure near the small end will diminish, owing to the necessary bending and shear set up at that part. Continued grinding either causes the tip to break off (*b*), or forms a quasi-cylindrical end (*c*), according to the brittleness or pliability of the material. (The wire-like end (*c*) is analogous to the "wire edge" formed when grinding a slightly soft knife or chisel.)

The harder the material and the more obtuse the cone, the nearer to the geometrical apex will the break occur.

In the ground diamond points which I have examined the end is rounded, and the lines of diffraction gratings ruled by them are merely very shallow grooves, as may be seen if thin sections are made of celluloid or gelatine casts. Casts taken from a Rowland grating of about 17,000 lines per inch gave spectra nearly as brilliant as the grating itself, but the depth of the grooves was not distinguishable even when viewed with an immersion twelfth objective. I have been told that in ruling these gratings the load on the point was 3 or 4 grains, and if this is the case the whole of the ruled surface must have been sunk below that of the original level. In casts from some of my own gratings of 5000 per inch, the grooves, though shallow, could be readily distinguished. Each groove was the full 1/5000 in. across, and I know now that the load on the point was excessive (see Fig. 12).

The natural edges of splinters of diamond offer sharper points than can be attained by grinding, and I believe that the finest ruling could be made with such splinters, properly mounted, if they could be applied with a sufficiently light load.

Many orders of plants form hard points, which, according to Bentham, should be called "thorns" when developed from the wood, and "spines" or "prickles" when products of the epidermis.

These points are often said to be "as sharp as needles," and at various times I have examined a great variety of them in order to determine their real dimensions. Figs. 6–10 are traced from photographs, but only in the barbs of the spines of some cacti have I found any natural points which approached the sharpness of a needle. As a rule "thorns" are much blunter than "spines" or "prickles."

A. MALLOCK.

9 Baring Crescent, Exeter, August 16.

Biological Terminology.

I SUSPECT that there are many others of the rank and file like myself who have followed this correspondence, and feel, like a man who is a bad guesser of riddles, that there is somewhere in the questions asked by Sir Archdall Reid a "catch," and cannot yet see it. Of course, he is too busy and earnest a worker in science to ask mere riddles, and many would be thankful for a concise statement of what has been gained so far. The leading biologists have held aloof lately, and the physiologists seem disinclined to answer the appeal made to them. Is this because Sir Archdall Reid has convinced both these groups, or because they are indifferent to the issues raised, or because they are waiting for them to be put explicitly and some proposals made?

Sir Archdall Reid is liberal enough to allow us to give up for the moment the familiar examples of a "head" and a "scar," and even the blacksmith's arm. The last of these is too imaginary a case to be of much use, for no one, so far as I know, has produced a series of, say, twenty generations of blacksmiths, male and female, and demonstrated the effect or non-effect of the special use of the blacksmith's muscles on those of his clerical descendant. I am sure he will allow me to bring forward a simpler and lowlier example which appears in a book written by me and reviewed in NATURE of June 2, p. 419. It is chosen from the mode of arrangement of the hair on the ventral surface of the domestic horse's neck, and I have contended that certain patterns found here are inherited and produced by the frequently repeated stimuli of friction in draught horses due to the collar. It may, I think, be granted:—

(1) That the domestic horse is descended from a wild form of the Equidæ, and it shares with the zebra, kiang, and onager a uniform slope of hair from the lower jaw to the chest.

(2) That numerous and varied patterns are found in place of this "normal" slope in a certain large number of horses to-day, and these are attributable to the friction of the moving collar through many generations. The inference here may be wrong or right, but this does not affect the bearing of the example on Sir Archdall Reid's questions to biologists as to what they mean when they speak of "acquired characters." It is legitimate, therefore, to speak of a horse in respect of this character as "normal" or "abnormal," the latter having patterns or reversed areas of hair, the former none. The normal horse

©1921 Nature Publishing Group

has thus inherited the uniform slope of hair which, I believe, is common to all mammals, but at some distant period of its evolution the abnormal horse began to assume the incipient variation because its ancestors were subject to friction from a collar *sufficient to produce it*, whereas the normal horse and its ancestors were not. We may surely to-day call these patterns "acquired characters," though their initial stages were too slight to be discovered. In such an inquiry as this, if we look away from the slight initial stages and concentrate attention only on fully formed "characters," we become bemused by this unfortunate term with all its implications. How does it help our view of the matter to call both the normal and abnormal slope "acquired" because the horse inherits the potentiality of responding thus to the stimuli of friction? If we must do so, we shall have to find some fresh term for the initial stages and changes of structure. Would Semon's conception embodied in the word "engram" not suit the case? On his hypothesis "engrams" are transmitted after the operation of a sufficient number of stimuli.

Will Sir Archdall Reid then tell us what he thinks of such initial variations as the one I have chosen, and what we should call them, if not "engrams"? These considerations are apart from the complications of inheritance introduced by bisexual reproduction and its shuffling effect on variations. Walter Kidd.

2 Suffolk Square, Cheltenham, August 19.

The "Radiant" Spectrum.

The title refers to an interesting optical effect observed and described many years ago by Sir David Brewster (*Phil. Mag.*, September, 1867), which appears, however, never to have been satisfactorily explained. When a small brilliant source of light is viewed through a prism held in front of the eye, a remarkable appearance is noticed, represented roughly in the accompanying diagram (Fig. 1). In the continuation of the spectrum of the source, but considerably beyond its violet end, is seen a patch of light consisting of streamers radiating from a centre, as shown. A brief statement on the cause of this effect, as determined in an investigation made by me, may be of interest to readers of Nature.

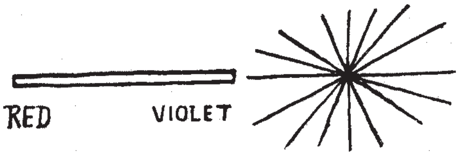


Fig. 1.

The phenomenon is due to the diffraction of light in its passage through the eye by the corneal corpuscles. Were there no prior dispersion of the light by the prism, the diffraction-halo would appear to consist of streamers surrounding the source and radiating from it directly. The effect of the dispersion on the diffraction-halo is to shift its achromatic centre towards the side of the shorter wave-lengths—in fact, to a point lying considerably beyond the violet of the spectrum of the source, exactly as observed. The streamers in the halo really consist of elongated diffraction-spectra, and the effect of the prism is to re-orient them, so that they now appear to diverge from the altered position of the achromatic centre. This explanation of Brewster's phenomenon is strikingly confirmed by the fact that very similar effects may be observed in the diffraction-halo due to a glass plate dusted with lycopodium, when held in front of the eye along with a 60° glass prism.

C. V. Raman.

22 Oxford Road, Putney, S.W.15.
August 12.

Remarkable July Rainfall at Blue Hill, Mass.

In connection with the present abnormal season in North-Western Europe, it may be of interest to note that July, 1921, was not only the wettest July, but also the wettest month of any at Blue Hill since observations began thirty-six years ago. The co-ordinates of the observatory are $\phi = 42^\circ\ 12'\ 44''$ N., and $\lambda = 71^\circ\ 6'\ 53''$ W. Every effort has been made to preserve the integrity of the record. The total rainfall for July was 261 mm. (10·43 in.), the normal rainfall for that month being 99 mm. (3·92 in.). There were eleven rainy days, and one on which a trace of rain fell.

So far as frequency is concerned, it was a normal month.

It is difficult to characterise properly the rainfall of a summer month, owing to variability in the intensity of thunder showers. During the past month there were no remarkably heavy downpours such as distort monthly totals. Also there was on the last day of June a heavy rainfall which, if allowed for, easily makes the period one of maximum rainfall. By comparison with long-period records at New Bedford, 68 km. south (107 years), and Boston, 16 km. north (103 years), it is evident that the rainfall of July, 1921, is the heaviest in a century. With the exception of August, 1826, when at New Bedford 475 mm. was recorded, half of which, however, fell in 72 hours, the past month can be regarded as the wettest period in this section for more than a century.

Furthermore, this section of the North Atlantic coast is evidently in a period of maximum rainfall. At Blue Hill the data are as follows (in the upper row normal 35-year-period rainfalls; in lower rows the departures for 1920 and 1921):—

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
35 years mm.	103	101	110	94	91	80	99
1920	−20	+88	+25	+69	+101	+139	−22
1921	−8	−1	−38	+36	+41	+30	+166

Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Year/12.
100	104	99	96	98	1179	98
+25	−28	−42	+76	+23	1621	135
—	—	—	—	—	—	150 (?)

Alexander McAdie.

Harvard University, Blue Hill Observatory,
Readville, Mass., August 1.

The "Philosophical Magazine."

A letter which appears to have been widely circulated has reached me from the National Union of Scientific Workers virtually attacking the management of the *Philosophical Magazine*. Will you allow me, therefore, briefly to say that the referees mentioned on the title-page of that journal are frequently consulted, and that their services are not so nominal as the writers of the circular suppose?

I would add that, in my judgment, the *Philosophical Magazine* is well managed; that a conservative attitude towards old-established organs is wise; and that it is possible to over-organise things into lifelessness.

Oliver Lodge.

©1921 Nature Publishing Group